UNITED STATES PATENT APPLICATION FOR:

APPARATUS AND METHOD FOR ORIENTATING A DOWNHOLE CONTROL TOOL

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APPARATUS AND METHOD FOR ORIENTATING A DOWNHOLE CONTROL TOOL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit of a Norwegian patent application serial number NO 20025798, filed December 03, 2002, which is herein incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] This invention regards a downhole controlled tool. Specifically, it concerns an arrangement for controlling a tool such as a high pressure water cutter in a manner such that the tool can follow any path, preferably cylindrical, within its working area.

Description of Related Art

[0003] Wellbore operations have traditionally been carried out by means of relatively heavy tools. As an example, perforation of a casing is known to be carried out through use of conventional drilling equipment. Such equipment is heavy and costly, especially when it has to be procured after the drilling operations have come to an end. Simpler methods have gradually been developed, which are designed to be used e.g. when cutting with a high pressure water cutting material.

[0004] In the following, reference is made, for illustrative purposes, to the control of a high pressure water cutter; however the arrangement of the invention is equally suited for other operations.

[0005] When cutting an opening in a casing wall it is often expedient to simultaneously cut the portion of the pipe wall which is to be cut out, into pieces that after they have come loose, are small enough not to represent a danger to the performance of the tool or adjoining equipment.

[0006] Previously known techniques of controlling cutting tools or other tools in a wellbore do not exhibit the required accuracy and stability for carrying out the above operations with sufficient precision.

[0007] The object of the invention is to remedy the disadvantages of previously known techniques.

[0008] The object is achieved in accordance with the invention by the characteristics given in the appended claims.

Summary of the Invention

[0009] The arrangement of the invention comprises an energy section, a controller, a first anchor and possibly a second anchor. Together, the sections form an elongated tool, the upper end portion of which is typically connected to a pipe string, coiled tubing or a wireline, possibly combined by means of a transition piece. The energy required for operation and control may be stored in the energy section and/or be supplied from the surface. Preferably, the work tool, for example a high pressure water cutter, is connected to the lower end portion of the elongated tool.

[0010] The actuator section comprises an axial displacement part and a rotational part, where the axial displacement part is designed to move the work tool along the wellbore, while the rotational part is designed to rotate the tool about the longitudinal axis of the wellbore. The axial displacement part and the rotational part are both associated with a programmable controller. The programmable controller is designed to steer the work tool along any path within the working area of the cutting tool.

[0011] If the length of the opening to be cut exceeds the length of stroke of the axial displacement part, the elongated tool may be fitted with two anchors to allow the well tool to be indexed accurately in the longitudinal direction of the wellbore.

[0012] The elongated tool is displaced into the wellbore and positioned at the work area. The work tool displaces the cutting tool in the axial direction of the wellbore by means of the axial displacement part and the cutting tool is rotated about the central axis of the wellbore by the rotational part, the cutting tool following the programmed path while high pressure water discharges from the operating nozzle of the cutting tool when the work tool comprises a cutting tool.

[0013] If required, the control of the axial displacement part and the rotational part may be performed manually and remotely by disabling or overriding the control programme.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The following describes a non-limiting example of a preferred embodiment illustrated in the accompanying drawings, in which:

[0015] Figure 1 shows an elongated well tool comprising a controlled work tool;

[0016] Figure 2 is an enlargement of the lower portion of the elongated tool; and

[0017] Figure 3 shows a simplified schematic circuit diagram for the actuator section.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0018] In the drawings, reference number 1 denotes an elongated well tool comprising an energy section 2, a valve section 4, a first anchor 6 and a second anchor 8. A telescoping, rotationally rigid axial displacement part 10 is arranged between the first anchor 6 and the second anchor 8.

[0019] In this preferred embodiment the telescopic part 12 of the axial displacement part 10 is constituted by a piston rod.

[0020] A rotational part 14 is connected to the second anchor 8, see figure 1. In figure 2 the rotational part 14 is connected to the telescopic part 12, the second anchor 8 being omitted.

[0021] A work tool in the form of a cutting tool 16 is connected to the opposite, downward facing portion of the rotational part 14.

[0022] The upper end portion of the elongated well tool 1 is connected to coiled tubing 18 by means of a transition piece 19.

[0023] The axial displacement part 10 is equipped with a position transmitter 20 designed to provide information regarding the relative position of the telescopic part 12 via a line 24 to a controller 22. An angle transmitter 26 is connected to the rotational part 14 and is designed to provide information regarding the relative angular position of the rotational part 14 via a line 28 to the controller 22.

[0024] The axial displacement part 10 and the rotational part 14 receive working fluid from the valve section 4 via pipe connections 30 and 32 respectively.

[0025] The servo valves (not shown) of the valve section 4 receive working fluid from the energy section 2 via pipe connections 34 and are controlled by the controller 22 via lines 36. The controller 22 communicates with corresponding equipment (not shown) on the surface in a known manner.

[0026] After the elongated tool 1 has been positioned in a casing 40 where an opening 42 is to be cut in the pipe wall of the casing 40, see figure 2, the elongated tool is secured to the casing 40 by the first anchor 6 in a manner that is known per se.

[0027] The cutting nozzle 44 of the cutting tool 16 is oriented into the correct position by means of the axial displacement part 10 and the rotational part 14, whereupon the cutting nozzle 44 is steered along a desired path while delivering high pressure cutting water.

[0028] The control of the axial displacement part 10 and the rotational part 14 is implemented via the valve section 4 by means of a control programme in the controller 22 and/or from the surface.

[0029] Preferably, the material removed is cut into smaller pieces 46 in order to ensure that the cut-out material does not obstruct further work in the casing 40. The pieces 46 are illustrated by broken lines in the as yet not finished opening 42 in figure 2.

[0030] If the length of the opening 42 is to exceed the length of stroke of the axial displacement part 10, the second anchor 8 is anchored, whereupon the first anchor 6 is released and moved to a new, appropriate position. The first anchor 6 is anchored, whereupon the second anchor 8 is released prior to a new section of the opening 42 being cut.

[0031] The rotational part 14 may be disposed in any position between the upper anchor 6 and the cutting tool 16, and may be formed as an integral part of the axial displacement part 10.

[0032] In an alternative embodiment, the axial displacement part 10 and/or the rotational part 14 may be electrically driven.